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Impact of persistent pain symptoms on work absence, health status and employment 18 months following disabling work-related injury or illness

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ABSTRACT

Objectives While most individuals physically injured at work will make a complete medical recovery, a portion of workers will experience persistent pain following their injury. This study estimated persistent pain prevalence and its association with health and return-to-work outcomes 18 months following the incidence of a disabling work-related injury.

Methods We studied 1131 workers disabled by a work-related injury who were recruited from a sampling frame of disability benefit claimants in Ontario, Canada. Work injuries and claim benefits characteristics from administrative data were linked with measures of work status, pain symptoms, and physical and mental health obtained from telephone interviews completed 18 months postinjury. Associations of persistent pain symptoms with health and employment outcomes 18 months postinjury were estimated using multinomial and linear regression.

Results Roughly 30% of participants reported no pain symptoms in the previous 4 weeks, 45% reported mild pain symptoms and 25% reported severe pain symptoms accompanied by substantial functional impairment. Workers with severe pain symptoms were more likely to not be currently working at 18 months (33%) vs those without pain symptoms (16%), and had poorer self-reported physical and mental health. Workers with severe pain symptoms had higher probabilities of benefit durations of 12–18 months (OR=9.35), higher lost-earnings costs (~47.7% higher) and higher healthcare expenditure costs at 18 months (~125.9% higher) compared with those with no pain symptoms.

Conclusions Persistent pain symptom prevalence 18 months postinjury is high among workers disabled by a work-related injury and associated with substantial functional impairment and longer wage replacement benefit duration.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Work-related injuries are among the most common type of injuries among working aged adults. The more severe injury is, the higher likelihood of requiring a work disability absence.
⇒ A proportion of workers may experience persistent pain—pain that occurs for at least 3 months and impacts functional ability—after their work-related injury.
⇒ Less is known about the prevalence of persistent pain among workers who experience a work-related injury, and the association between persistent pain and time to return to work and cost of wage replacement following a disability claim.

WHAT THIS STUDY ADDS

⇒ In a cohort of ~1100 workers disabled by work injury that received lost time claim benefits, ~70% of workers experience at least mild persistent pain at 18 months postinjury, with 25% of the cohort reporting severe pain symptoms accompanied by functional impairment.
⇒ A graded effect between level of persistent pain symptoms and disability claim outcomes was seen: the shortest duration and lowest amount of lost earning benefits and healthcare-related benefits were seen among those reporting no persistent pain and highest among those with severe pain 18 months after the work-related injury.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study highlights the high prevalence of persistent pain among adults who experience a work-related injury, and the demographic, work and health profile of these individuals.
⇒ Findings from this study can be extended by exploring the role of healthcare access and experience on the association between persistent pain and return-to-work outcomes.

INTRODUCTION

The incidence of work-related injury is substantial among developed economies. Among working-aged adults, one of every six injuries requiring medical attention are caused by work exposures,[1] with ~35% of these work-related injuries resulting in periods of disability and work absence. A considerable proportion of work injury or illness results in some degree of permanent impairment. In a representative sample of Canadian adults, 25% of those with permanent disabilities attributed the underlying impairment to a work exposure.[2]

The economic burden of work-related injury and illness is considerable. The cost of non-fatal

occupational injuries and illness is approximately US$185.8B annually.[3] Much of this cost is attributed to durations of work disability among workers whose recovery requires periods of absence from work. Compelling evidence exists for the long-lasting adverse impacts of work disability episodes on injured workers' labour force participation and earnings.[4 5]

Chronic or persistent pain may occur after experiencing an injury that requires medical attention. Over the past two decades, approaches to defining chronic pain have been standardised, typically defined as pain of moderate or severe intensity that is persistent or recurrent for at least 3 months coupled with functional impairment, and cannot be better accounted for by an alternate medical diagnosis.[6 7] Recent definitions have distinguished between moderate pain syndromes with mild impairment and more severe pain with high impairment.[8 9]

An American study using a representative survey of ~15 000 adults reported a prevalence of chronic pain (pain occurring most days and at least one limitation in daily life lasting at least 3 months) of 16.8% among adults aged 18–64.[9] Applying similar measures, a representative survey of ~131 000 Canadians estimated chronic pain prevalence among adults aged 20 and older to be 18.5%, with 4.7% reporting no activity restrictions, 10.0% reporting a few or some activity restrictions, and 3.5% reporting limitations in most activities.[8] The prevalence of chronic pain is generally higher among women, increases with age,[6] and is correlated with poor mental health.[10 11]

The annual direct healthcare costs (not including lost productivity costs) associated with managing chronic pain in Canada is $C 7.2B, straining individuals and welfare systems.[12] Chronic pain has deleterious effects on maintaining employment and performing job duties.[13] In a European survey conducted on adults experiencing chronic pain, 19% of participants had lost their job due to pain, 16% changed job responsibilities, and 13% changed their job completely due to their pain.[13]

It is unclear how common persistent pain is among workers who experience a work-related injury. Little evidence exists quantifying how persistent pain following a work-related injury is associated with the time and disability costs it takes to return to work. Therefore, this study sought to (1) estimate the proportion of workers disabled by a work-related injury experiencing persistent pain 18 months after their injury occurred; (2) describe the demographic, health, work and disability-related profile of those experiencing persistent pain; and (3) quantify the association between persistent pain and return-to-work outcomes, defined by duration and cost of a disability claim.

METHODS

Sample

This study uses data from the Ontario Life After Work Injury Study (OLAWIS), a cohort study exploring health and labour market outcomes of workers in Ontario, Canada who were disabled by a physical work injury or illness and received lost-time claim benefits.[14] The Workplace Safety & Insurance Board (WSIB) is the single-payer, publicly administered workers' compensation insurance authority in Ontario that provides benefits to entitled workers who experience a work-related illness or injury. The WSIB administers benefits that cover medical care services and wage replacement where the injury leads to an absence from work. The WSIB provides incentives for timely return-to-work practices by employers through employer insurance premiums.

The OLAWIS study sample was composed of Ontario workers 18 years or older, who were employed by an insured employer, able to conduct an interview in English or French, and had experienced a physical work-related injury or occupational disease that resulted in a WSIB accepted lost-time compensation claim.[14] To obtain sufficient representation of more serious and complex claims, ~400 participants were to be recruited in each of three wage-replacement duration sample groups: short duration (1 day to 3 months), medium duration (3 to 12 months) and long duration, (12+ months). The short duration sample represented 85% of all lost-time claimants in the WSIB system, the medium duration sample represented 9% of all lost-time claimants, and the long duration sample represented 6% of all lost-time claimants.

Participant recruitment occurred between June 2019 and March 2020 in two phases. In the first phase, a WSIB representative randomly sampled monthly quotas of lost-time claimants meeting eligibility for the three sample groups. Lost-time claimants were then contacted and asked for their consent to share their name and contact information with the research team. A total of 2816 randomly sampled claimants were contacted, of which 1674 (59.4%) agreed to share their information.

In the second phase, a survey services contractor contacted consenting workers and conducted an interviewer-administered telephone interview. The survey services contractor could not establish contact with 385 claimants, received 125 interview refusals, and completed interviews with 1132 claimants (40.2% of eligible claimants, and 87.8% of eligible claimants successfully contacted). Among participants, 358 (31.6%) were in the short-duration claim sample, 374 (33.0%) were in the medium-duration claim sample and 400 (35.3%) were in the long-duration claim sample. More details of the study cohort may be found elsewhere.[14] This study included all cohort members who had information on persistent pain status at 18 months (n=1131).

Data collection

Primary outcome measures and potential predictors of the primary outcomes were drawn from WSIB administrative records and an interviewer-administered telephone questionnaire 18 months after the original injury occurred. Information from an 18-month follow-up of administrative records of work disability insurance benefits was integrated with the information obtained from an interviewer-administered questionnaire for the 94% of claimants consenting to this use and included measures of the nature of injury and injury event, benefit duration and expenditure, workers' occupation, geographical location, employer size and economic sector.

Study measures

Persistent pain

The study questionnaire included two questions related to persistent pain. The first question asked participants about pain interference, 'During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?', in which participants could respond: not at all, a little bit, moderately, quite a bit, or extremely (n=1131). Participants indicating at least a little pain interference were then asked, 'On a scale from 0 to 10, how would you rate your pain due to your injury at the PRESENT TIME (that is right now), where 0 is no pain and 10 is pain as bad as it could be?' (n=878). The first question originated in the RAND 36-Item Health Survey, an adaptation of the SF-36,[15] and the second question is an adaptation of the numerical rating scale for pain.[16] Both of these questions are commonly used for pain assessment by clinicians and researchers.

To align to persistent pain definitions proposed in previous literature,[17–20] we defined three pain groups based on pain symptoms over the past 4 weeks: (1) no pain, if participants responded that pain did not interfere with their normal activities; (2) mild pain with an unlikely or low impact on functional impairment, if participants reported that their pain interference was 'a little bit' or 'moderate', and their pain intensity score was less than 6/10; and (3) severe pain in which functional impairment was likely, if respondents reported pain interference of 'quite a bit', 'extremely' or their pain interference was 'moderate' but pain intensity score was greater or equal to 6/10.

Demographic, work, health and injury factors

Participants were asked about demographic, work, health-related and injury-related factors when surveyed at 18 months post-injury claim. Demographic factors measured included: participant age, sex (female vs male or not specified), highest level of education, country of birth, household income and industry at time of claim. Nature of injury was measured through administrative records (described further below). Participants were also asked if they were still receiving claim benefits, if this was their first WSIB claim, if they experienced financial difficulties during their work absence, and their current employment status. Respondents were asked about their healthcare experience (including receipt of healthcare for their injury, having multiple providers, if they were currently receiving healthcare and how stressful their healthcare experience was), as well as their current health profile (including prevalence of chronic conditions before and after the injury occurred, measures of overall physical and mental health, distress levels,[21] sleeping difficulties, cannabis use, opioid use and sedative use).

Return-to-work outcomes

We explored four disability-related outcomes: wage-replacement duration (less than 3 months; 3–12 months; 12–18 months), total number of loss of earnings (LOE) days, total amount of LOE benefit dollars, and total amount of healthcare expenditure benefits (in dollars). The latter three variables were ascertained through the WSIB administrative records. As ~6% of participants did not consent to the linkage use of their administrative record, this resulted in missing data. For the total number of LOE days ($n_{missing}$=141), participants not agreeing to be linked were assigned the number of days they reported receiving WSIB lost earnings benefits from the questionnaire (n=83). If they did not answer that question (n=12), participants were assigned a value of 39 days (the median value). For the LOE benefit amount ($n_{missing}$=95) and healthcare expenditure benefits ($n_{missing}$=117), we completed a multiple imputation using a predictive mean matching imputation model using the mice package in R software.[22] We specified 20 imputations, based on wage replacement duration group, age, sex, pain group and nature of injury.

Analysis

Analyses were completed in R software. We first stratified the cohort into three groups: those who reported experiencing no pain, those experiencing mild pain, and those who were experiencing severe pain. We explored distributions in proportions using χ^2 tests. Tests were completed using the unweighted sample and a sample that was reweighted to make inferences to the target population of all claimants (as longer duration claims were oversampled as part of the study design). For the pain groups, we compared the distribution of pain scores with a two-sample t-test.

For each pain group, we then explored differences in demographic, work, health, and injury characteristics (measured at the cohort inception), and return-to-work and recovery characteristics measured at 18 months postinjury. We compared variable distributions in the unweighted sample between pain groups using χ^2 tests for categorical variables and analysis of variance tests for continuous variables.

To explore the association between persistent pain and wage-replacement duration, we employed a multinomial logistic regression, comparing wage replacement durations of 3–12 months and 12–18 months to durations of less than 3 months. For the remaining outcome variables, we employed an ordinary least squares (OLS) regression in which the log of the outcome variables was regressed on pain group. This modelling approach takes into account the skewed nature of the outcome variable.[23] Each regression was adjusted for claimant age, sex, nature of injury, and presence of a back problem, arthritis, mood disorder or high blood pressure prior to the injury as they were key confounders of interest and unbalanced between pain groups. Lastly, regressions were stratified by participant sex to explore potential sex differences in chronic pain and return-to-work outcomes. These analyses were conducted in the unweighted sample. As those who have experienced a previous work-related injury may be at higher risk of reporting more pain symptoms, we ran a sensitivity analysis including if it was a participant's first WSIB claim as an additional predictor variable.

RESULTS

At 18 months postinjury claim, a total of 254 participants (30.2% of the weighted sample, 22.4% of the unweighted sample) reported no pain interference over the past 4 weeks, 479 participants (44.8% of the weighted sample, 42.4% unweighted) were categorised as having mild pain interference, and 398 participants were categorised as having severe pain interference (24.9% of the weighted sample, 35.2% of the unweighted sample) (table 1). The average pain score (unweighted) was statistically significantly higher among the severe pain (M=6.10, SD=2.23) group compared with the mild pain group (M=2.46, SD=1.95, t=25.76, p<0.001).

When exploring the cohort characteristics across pain groups (table 2), more participants were over 50 years old in the two persistent pain groups compared with the no pain group. A greater proportion of participants in the two pain groups were born outside of Canada, had annual household incomes less than $C 70 000, or reported back problems, arthritis or a mood disorder prior to the injury. No proportion differences in sex, highest education level, industry at time of claim, or nature of the injury were seen between the three groups. A greater proportion of those in the no pain group reported that this was their first disability claim (~65%).

At the 18-month follow-up (table 3), 16.1% of respondents with no pain, 18.2% of respondents with mild pain and 32.9% of respondents with severe pain reported not currently working. A gradient in outcomes was seen, in that persistent pain groups typically had a higher proportion of participants with unfavourable outcomes at 18 months, and generally this proportion was highest among the severe pain group. A higher proportion of participants in the severe pain group reported having a benefit duration of 12–18 months (52.0% vs 15.7% among the no pain group); a similar gradient was seen for the LOE duration, LOE benefit amount and healthcare benefits. Among those with severe pain, 35.9% reported still receiving WSIB benefits, 56.1% reported currently receiving healthcare for the treatment

Table 1 OLAWIS cohort, chronic pain profile

	Overall	No pain	Mild pain, functional impairment unlikely	Severe pain, functional impairment likely
N	**1131**	**254**	**479**	**398**
During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?				
N	**1131**	**254**	**479**	**398**
Not at all	254 (22.5)	254 (100.0)	0 (0.0)	0 (0.0)
A little bit	287 (25.4)	0 (0.0)	287 (59.9)	0 (0.0)
Moderately	235 (20.8)	0 (0.0)	192 (40.1)	43 (10.8)
Quite a bit	209 (18.5)	0 (0.0)	0 (0.0)	209 (52.5)
Extremely	146 (12.9)	0 (0.0)	0 (0.0)	146 (36.7)
On a scale from 0 to 10, how would you rate your pain due to your injury at the PRESENT TIME (that is right now), where 0 is no pain and 10 is pain as bad as it could be?				
N	**876**		**479**	**397**
0	131 (15.0)	NA	116 (24.2)	15 (3.8)
1	50 (5.7)	NA	48 (10.0)	2 (0.5)
2	92 (10.5)	NA	78 (16.3)	14 (3.5)
3	110 (12.6)	NA	92 (19.2)	18 (4.5)
4	91 (10.4)	NA	63 (13.2)	28 (7.1)
5	107 (12.2)	NA	61 (12.7)	46 (11.6)
6	96 (11.0)	NA	11 (2.3)	85 (21.4)
7	94 (10.7)	NA	5 (1.0)	89 (22.4)
8	62 (7.1)	NA	4 (0.8)	58 (14.6)
9	23 (2.6)	NA	0 (0.0)	23 (5.8)
10	20 (2.3)	NA	1 (0.2)	19 (4.8)
Mean (SD)	**4.11 (2.75)**	**NA**	**2.46 (1.95)**	**6.10 (2.23)**
Median (IQR)	**4.00 (2.00, 6.00)**	**NA**	**2.00 (1.00, 4.00)**	**6.00 (5.00, 8.00)**

NA, not available; OLAWIS, Ontario Life After Work Injury Study.

of the disabling injury, 20.2% reported an opioid prescription in the past year and roughly half reported poor/fair physical and mental health.

When compared with no pain, mild pain at 18 months was associated with wage replacement durations of 12–18 months (OR 3.09, 95% CI 1.99 to 4.81) compared with durations less than 3 months (table 4). Severe pain at 18 months post injury was associated with increased odds of having a wage replacement duration of 3–12 months (OR 2.04, 95% CI 1.34 to 3.10) or 12–18 months (OR 9.35, 95% CI 5.85 to 14.94) when compared with durations less than 3 months. When using the 3–12 month wage duration group as reference, those with mild pain (vs no pain, OR 2.38, 95% CI 1.53 to 3.72) and severe pain at 18 months postinjury (OR 4.58, 95% CI 2.92 to 7.20) had higher odds of belonging to the 12–18 month wage replacement group (online supplemental table 1). Associations were not attenuated when adjusted for the preinjury prevalence of chronic conditions and were generally of similar magnitude and direction for men and women (online supplemental table 2).

After controlling for age, sex, nature of injury and prior chronic conditions, experiencing mild pain was associated with an average of 11.6% more total LOE days (not statistically significant), whereas experiencing severe pain was associated with an average of 51.1% more LOE days (95% CI 30.0% to 72.2%) when compared with those who experienced no pain (table 5). Similar associations were seen for amount of LOE benefits received: if a participant had reported severe pain at 18 months, the amount of LOE benefits received was 47.7% greater vs those who did not report pain (95% CI 25.4% to 69.9%). Experiencing either mild or severe pain was associated with higher amounts of healthcare expenditure benefits (mild pain vs no pain: β=47.9%, 95% CI 22.5% to 73.2%; severe pain vs no pain: β=125.9%, 95% CI 99.7% to 152.2%). These associations were of similar magnitude and direction for men and women (online supplemental table 3). In our sensitivity analysis, results were not attenuated when adjusting for first disability claim (online supplemental tables 4 and 5).

DISCUSSION

This study describes a high prevalence of persistent pain in a cohort of workers who experienced a disabling work-related injury. Weighted to represent the population of all workers in Canada's most populous province disabled by a work-related injury or illness, ~70% of the cohort indicated experiencing pain 18 months following a disabling work-related injury, with 24.9% reporting severe pain intensity with substantial functional impairment. The prevalence of severe persistent pain in this cohort is approximately six times higher than Canadian and US adult populations, where ~4% of adults experience persistent pain that limits most activities.[8 9] While the prevalence of persistent pain is likely similar to other cohorts of disabled workers,[9 13] the consequences of persistent pain may differ depending on the generosity of a jurisdiction's work disability insurance scheme.

A dose–response gradient was seen in the disability-related return-to-work outcomes. Compared with participants with no pain, participants with mild persistent pain demonstrated three times greater odds of having a wage-replacement duration of at least a year, and participants with severe persistent pain had nine times greater odds of having a wage-replacement duration of at least a year. Persistent pain was also associated with the total amount of LOE and healthcare-related disability benefits participants received. This high burden of persistent pain draws attention to the important contribution of work-related traumatic

Table 2 OLAWIS cohort demographic, work, health and injury characteristics at cohort inception, by persistent pain status

	All respondents	No pain	Mild pain, functional impairment unlikely	Severe pain, functional impairment likely	P value
N	1131	254	479	398	
Row per cent, unweighted (weighted)	100.0	22.4 (30.2)	42.4 (44.8)	35.2 (24.9)	
Age, mean (SD)	47.37 (12.81)	44.45 (13.90)	47.86 (12.42)	48.66 (12.29)	<0.001
Age, by decade, n (%)					
Less than 30 years old	145 (12.8)	49 (19.3)	54 (11.3)	42 (10.6)	
30–39 years old	183 (16.2)	49 (19.3)	80 (16.7)	54 (13.6)	
40–49 years old	228 (20.2)	49 (19.3)	85 (17.7)	94 (23.6)	
50–59 years old	371 (32.8)	68 (26.8)	178 (37.2)	125 (31.4)	
Over 60 years old	204 (18.0)	39 (15.4)	82 (17.1)	83 (20.9)	
Female sex, n (%)	497 (43.9)	98 (38.6)	220 (45.9)	179 (45.0)	0.329
Highest level of education, n (%)					0.131
High school diploma or less	461 (40.8)	91 (35.8)	192 (40.1)	178 (44.9)	
College degree or trade certification	416 (36.8)	96 (37.8)	178 (37.2)	142 (35.9)	
Undergraduate or graduate degree	252 (22.3)	67 (26.4)	109 (22.8)	76 (19.2)	
Country of birth, outside Canada, n (%)	263 (23.3)	50 (19.8)	103 (21.5)	110 (27.6)	0.033
Household income ($C), n (%)					0.001
<$40K	183 (18.3)	27 (12.1)	72 (16.8)	84 (24.0)	
$40–$69K	195 (19.5)	39 (17.4)	84 (19.6)	72 (20.6)	
$70–$99K	227 (22.7)	53 (23.7)	89 (20.8)	85 (24.3)	
$100–$129K	185 (18.5)	46 (20.5)	81 (18.9)	58 (16.6)	
≥$130K	212 (21.2)	59 (26.3)	102 (23.8)	51 (14.6)	
First WSIB claim, n (%)	610 (56.0)	165 (65.0)	260 (56.6)	197 (51.4)	0.036
Industry at time of claim, n (%)					0.209
Healthcare and social assistance	170 (15.0)	38 (15.0)	76 (15.9)	56 (14.1)	
Construction, utilities, mining, agriculture, forestry	156 (13.8)	32 (12.6)	70 (14.6)	54 (13.6)	
Transportation and warehousing	147 (13.0)	32 (12.6)	55 (11.5)	60 (15.1)	
Manufacturing	142 (12.6)	22 (8.7)	72 (15.0)	48 (12.1)	
Other services (except public administration)	139 (12.3)	32 (12.6)	61 (12.7)	46 (11.6)	
Retail, wholesale trade	93 (8.2)	22 (8.7)	34 (7.1)	37 (9.3)	
Educational services	99 (8.8)	29 (11.4)	45 (9.4)	25 (6.3)	
Accommodation/food services/ arts/ Entertainment	87 (7.7)	19 (7.5)	28 (5.8)	40 (10.1)	
Public administration	66 (5.8)	19 (7.5)	26 (5.4)	21 (5.3)	
Other	32 (2.8)	9 (3.5)	12 (2.5)	11 (2.8)	
Nature of injury, n (%)					0.513
Sprain, strain, or dislocation	551 (48.7)	113 (44.5)	237 (49.5)	201 (50.5)	
Fracture	140 (12.4)	36 (14.2)	56 (11.7)	48 (12.1)	
Superficial or open wound	125 (11.1)	28 (11.0)	62 (12.9)	35 (8.8)	
Organ/blood vessel/muscle injury, internal injury, crushing, amputation	140 (12.4)	32 (12.6)	57 (11.9)	51 (12.8)	
Other	44 (3.9)	13 (5.1)	19 (4.0)	12 (3.0)	
Unknown	131 (11.6)	32 (12.6)	48 (10.0)	51 (12.8)	
Prevalence of chronic conditions, preinjury					
Back problems, n (%)	188 (16.8)	28 (11.1)	90 (19.0)	70 (17.7)	0.02
Arthritis, n (%)	190 (16.9)	23 (9.1)	86 (18.0)	81 (20.5)	0.001
Migraine, n (%)	191 (16.9)	33 (13.0)	87 (18.3)	71 (17.8)	0.159
Mood disorder, n(%)	120 (10.7)	20 (7.9)	41 (8.6)	59 (14.9)	0.003
High blood pressure, n (%)	168 (14.9)	32 (12.6)	66 (13.8)	70 (17.8)	0.133

OLAWIS, Ontario Life After Work Injury Study; WSIB, Workplace Safety & Insurance Board.

injury and non-traumatic musculoskeletal disorders to the population burden of chronic pain.

A dose–response gradient was seen in the majority of health-related variables measured across pain groups at 18 months post-injury. A gradient across the three pain symptom groups was seen for participants taking prescription opioids, sedative use, and self-reported physical and mental health. A similar gradient was observed for healthcare utilisation. For example, 6% of participants in the no pain group were still receiving healthcare for the injury at 18 months, compared with 28% of participants in the

Table 3 OLAWIS cohort, return to work and recovery status at 18-month follow-up, by persistent pain status

	All respondents (n=1131)	No pain (n=254)	Mild pain, functional impairment unlikely (n=479)	Severe pain, functional impairment likely (n=398)	P value
Current employment status, n (%)					<0.001
Working with at injury employer	695 (61.5)	165 (65.0)	312 (65.1)	218 (54.8)	
Working with different employer	177 (15.6)	48 (18.9)	80 (16.7)	49 (12.3)	
Not currently working	259 (22.9)	41 (16.1)	87 (18.2)	131 (32.9)	
Sample group, n (%)					<0.001
Benefit duration 1 day-3 months	358 (31.7)	119 (46.9)	164 (34.2)	75 (18.8)	
Benefit duration 3–12 months	373 (33.0)	95 (37.4)	162 (33.8)	116 (29.1)	
Benefit duration 12–18 months	400 (35.4)	40 (15.7)	153 (31.9)	207 (52.0)	
Loss of earnings duration (days)*, mean (SD)	71.93 (88.40)	55.30 (64.10)	62.45 (80.40)	93.58 (105.13)	<0.001
Loss of earnings*, $C, mean (SD)	7885 (11,087)	6026 (7,215)	7223 (10,391)	9890 (13,461)	<0.001
Median	4132	3206	3450	5183	
Healthcare benefits*, $C, mean (SD)	7398 (13,186)	4064 (6,551)	6335 (11,378)	10 841 (17,122)	<0.001
Median	2657	1466	2144	5288	
Current WSIB services, n (%)	223 (19.8)	9 (3.5)	72 (15.1)	142 (35.9)	<0.001
Received healthcare for injury, n (%)	1067 (94.4)	232 (91.3)	450 (94.1)	385 (96.7)	0.013
Current healthcare for injury, n (%)	356 (33.5)	14 (6.0)	127 (28.4)	215 (56.1)	<0.001
Seen multiple healthcare providers for injury, n (%)	872 (81.7)	178 (76.7)	357 (79.3)	337 (87.5)	0.001
Stressful healthcare experience (%)					<0.001
Not at all stressful	627 (58.8)	166 (71.6)	278 (61.9)	183 (47.5)	
Not very stressful	163 (15.3)	30 (12.9)	76 (16.9)	57 (14.8)	
A bit stressful	157 (14.7)	17 (7.3)	65 (14.5)	75 (19.5)	
Quite a bit stressful	76 (7.1)	10 (4.3)	24 (5.3)	42 (10.9)	
Extremely stressful	43 (4.0)	9 (3.9)	6 (1.3)	28 (7.3)	
Prescription opioid use (past year), n (%)	151 (13.5)	13 (5.1)	60 (12.6)	78 (20.2)	<0.001
Prescription sedative use (past year) n (%)	272 (24.2)	34 (13.4)	94 (19.7)	144 (36.5)	<0.001
Poor/fair physical health, n (%)	294 (26.0)	13 (5.1)	76 (15.9)	205 (51.5)	<0.001
Poor/fair mental health, n (%)	313 (27.7)	32 (12.6)	88 (18.4)	193 (48.7)	<0.001
Kessler Distress Scale (K6) Score >12, proportion (SD)	169 (15.1)	12 (4.7)	30 (6.3)	127 (32.2)	<0.001
Trouble going to or staying asleep, n (%)					<0.001
All of the time	187 (16.6)	12 (4.7)	58 (12.1)	117 (29.5)	
Most of the time	265 (23.5)	31 (12.2)	102 (21.3)	132 (33.2)	
Sometimes	324 (28.7)	78 (30.7)	151 (31.6)	95 (23.9)	
Rarely	182 (16.1)	67 (26.4)	85 (17.8)	30 (7.6)	
Never	171 (15.1)	66 (26.0)	82 (17.2)	23 (5.8)	
Financial difficulties during work absence, n (%)					
Yes	576 (51.2)	79 (31.2)	222 (46.5)	275 (69.8)	<0.001
Any cannabis use in the past year, n (%)					
Yes	349 (30.9)	70 (27.6)	136 (28.4)	143 (35.9)	<0.001

$C indicates that values are in Canadian dollars.
*Indicates outcome variables. Non-imputed mean and median values shown.
OLAWIS, Ontario Life After Work Injury Study; WSIB, Workplace Safety & Insurance Board.

mild pain group and 56% in the severe pain group. Measures of self-reported healthcare utilisation were mirrored in estimates of healthcare service benefit expenditure from administrative records and are consistent with estimates obtained from previous studies.[24]

While early studies of disability episode duration following a work-related injury have documented the relationship between high pain symptoms in the acute period of injury recovery and longer durations of work disability,[25] few studies have estimated the persistence of high pain symptoms beyond the acute period of injury recovery. As an example of the latter, among a cohort of Ontario workers disabled by a back injury or upper extremity musculoskeletal disorder, the mean pain intensity score was 4.6 at a 12-month follow-up interview.[26] Although the precise contribution to the population burden of chronic pain is unclear, traumatic injury's role in the aetiology of persistent pain symptoms is recognised.[27 28] In Canadian surveys of individuals with chronic pain,~15% attributed their chronic pain to a traumatic injury.[18] Consistent with this emerging recognition of the aetiology of chronic pain, proposed revisions to the classification of chronic pain in the international classification of diseases (ICD-11) includes 'chronic postsurgical and post-traumatic pain' as one of seven aetiological categories.[29]

We have confidence that the burden of persistent pain documented in our study is a consequence of the injury that resulted in an episode of work disability. It is unlikely that the high burden of persistent pain observed in this cohort of workers was prevalent prior to the incidence of a disabling work-related

Table 4 Adjusted multinomial logistic regression models for the associations between persistent pain status at 18 months and wage replacement duration group, overall cohort (n=1131)

		Wage replacement duration 3–12 months vs 1 day to 3 months								Wage replacement duration 12–18 months vs 1 day to 3 months							
		Model 1				Model 2				Model 1				Model 2			
		OR	95% CI		P value	OR	95% CI		P value	OR	95% CI		P value	OR	95% CI		P value
	Model intercept	0.70	0.44	1.12	0.14	0.76	0.47	1.21	0.25	**0.24**	**0.14**	**0.41**	**<0.01**	**0.25**	**0.15**	**0.44**	**<0.01**
Pain group	Mild pain, functional impairment unlikely	1.29	0.90	1.85	0.17	1.30	0.90	1.87	0.16	**2.93**	**1.90**	**4.52**	**<0.01**	**3.09**	**1.99**	**4.81**	**<0.01**
Ref: no pain group	Severe pain, functional impairment likely	**2.00**	**1.33**	**3.02**	**<0.01**	**2.04**	**1.34**	**3.10**	**<0.01**	**8.46**	**5.35**	**13.38**	**<0.01**	**9.35**	**5.85**	**14.94**	**<0.01**
Claimant age	<30 years old	0.63	0.37	1.09	0.10	0.63	0.36	1.09	0.10	0.79	0.45	1.41	0.43	0.79	0.44	1.42	0.43
Ref: 30–39 years old	40–49 years old	0.95	0.58	1.55	0.85	0.95	0.58	1.55	0.83	1.10	0.66	1.84	0.72	1.13	0.67	1.91	0.65
	50–59 years old	1.20	0.77	1.88	0.41	1.23	0.78	1.93	0.37	1.33	0.83	2.14	0.23	1.35	0.83	2.19	0.23
	Over 60 years old	1.20	0.71	2.01	0.49	1.14	0.67	1.94	0.62	**1.77**	**1.04**	**3.01**	**0.03**	**1.75**	**1.02**	**3.01**	**0.04**
Sex	Female	0.84	0.62	1.14	0.26	0.83	0.61	1.13	0.23	0.82	0.60	1.12	0.20	0.85	0.62	1.17	0.32
Ref: male and other not specified																	
Nature of injury	Fracture	**2.72**	**1.61**	**4.61**	**<0.01**	**2.74**	**1.61**	**4.65**	**<0.01**	**2.96**	**1.72**	**5.10**	**<0.01**	**2.98**	**1.72**	**5.16**	**<0.01**
Ref: sprain/strain/dislocation	Superficial or open wound	**0.50**	**0.30**	**0.84**	**0.01**	**0.50**	**0.30**	**0.83**	**0.01**	0.70	0.43	1.13	0.15	0.71	0.44	1.16	0.17
	Organ/blood vessel/muscle injury, internal injury, crushing, amputation	1.33	0.83	2.15	0.24	1.36	0.84	2.20	0.21	**1.56**	**0.96**	**2.53**	**0.07**	**1.57**	**0.97**	**2.56**	**0.07**
	Other	**3.64**	**1.70**	**7.79**	**<0.01**	**3.71**	**1.73**	**7.95**	**<0.01**	0.52	0.15	1.74	0.29	0.53	0.16	1.78	0.30
	Unknown	1.47	0.87	2.47	0.15	1.46	0.85	2.50	0.17	**2.29**	**1.37**	**3.80**	**<0.01**	**2.30**	**1.36**	**3.90**	**<0.01**
Prior chronic condition	Back problems prior to the work injury	--	--	--	--	0.86	0.57	1.30	0.47	--	--	--	--	**0.65**	**0.42**	**1.00**	**0.05**
Ref: no prior condition	Arthritis prior to the work injury	--	--	--	--	0.95	0.62	1.47	0.82	--	--	--	--	1.04	0.68	1.61	0.84
	Mood disorder prior to the work injury	--	--	--	--	**0.64**	**0.40**	**1.03**	**0.07**	--	--	--	--	**0.45**	**0.27**	**0.76**	**<0.01**

Model 1 independent variables: pain group, claimant age, sex and nature of injury. Model 2 independent variables: Model 1+ presence of back problems prior to the work injury, presence of arthritis prior to the work injury and presence of a mood disorder prior to the work injury. Bold values indicate OR statistically significant at the α=0.05 level.

Table 5 Associations between persistent pain status at 18 months and lost time disability claim benefit outcomes, overall cohort (n=1131)

Dependent variable 1: total number of LOE days		B	95% CI	
Intercept	Intercept	**3.191**	**2.933**	**3.449**
Pain group	Mild pain, functional impairment unlikely versus no pain	0.116	−0.087	0.320
	Severe pain, functional impairment likely versus no pain	**0.511**	**0.300**	**0.722**
Dependent variable 2: total amount of LOE benefits				
Intercept	Intercept	**7.925**	**7.654**	**8.197**
Pain Group	Mild pain, functional impairment unlikely versus no pain	0.134	−0.079	0.348
	Severe pain, functional impairment likely versus no pain	**0.477**	**0.254**	**0.699**
Dependent variable 3: total amount of healthcare expenditure benefits				
Intercept	Intercept	**6.983**	**6.661**	**7.304**
Pain group	Mild pain, functional impairment unlikely versus no pain	**0.479**	**0.225**	**0.732**
	Severe pain, functional impairment likely versus no pain	**1.259**	**0.997**	**1.522**

Bold values indicate statistically significant estimate at the α=0.05 level. Analyses adjusted for age, sex, nature of injury and prior chronic conditions. Regression coefficients interpreted as a 'β% increase' in the dependent variable per each unit increase in the independent variable. For example in dependent variable 1 (total number of LOE days), the coefficient of mild pain functional impairment unlikely vs no pain (β=0.116) can be interpreted as: those with mild pain had a total number of LOE days 11.6% higher, on average, compared with those with no pain.
LOE, loss of earnings.

injury or illness. Respondents were specifically asked to describe pain intensity that they attributed to their disabling work-related injury. That all members of the cohort were actively employed at the time of the disabling injury or illness suggests a low prevalence of functional impairment prior to the injury. Chronic condition prevalence associated with pain symptoms prior to the disabling injury or illness was equivalent to the prevalence of these conditions among working adults in Ontario (unpublished data, available from authors). Statistical adjustment for preinjury prevalence of these conditions did not attenuate the association between persistent pain and the probability of long-duration disability episodes at the 18-month interview. Among cohort members without pain symptoms at the 18-month interview, the proportion reporting poor or fair self-rated health (5.1%) was similar to the prevalence of poor/fair self-rated health among working adults in Ontario (6.0%, unpublished data, available from authors).

Overall, our findings indicate that persistent pain of severe intensity arising from work-related traumatic injury impedes the ability to return to work. Among the population of individuals who experience persistent pain, most are unable to work, yet express a desire to do so. In a European survey asking 487 chronic pain sufferers about their goals, only ∼26% were employed in some capacity, ∼31% were receiving workers compensation and 38% reported being able to return to work as a goal.[30]

This study found that three chronic conditions (back problems, arthritis and mood disorders) prior to the work injury did not attenuate the association between persistent pain and return-to-work outcomes following an injury. Previous literature suggests that these chronic conditions may increase the risk of work-related injuries[31] and time required to return to work.[32] This highlights the importance of safety and wellness initiatives in the workplace to reduce the risk of both chronic conditions and work-related injuries.

Limitations

Measurement bias may exist in the persistent pain definition, as the questions ask about whether pain interference occurred in the past month, compared with the 3–6 months that is typically used to define chronic pain in the literature.[7] Despite having temporality, in which a work-related injury occurred at least 18 months prior, the result of having a shorter-time period in the questions used to define chronic pain could be that we might be overestimating the number of participants experiencing chronic pain. Related, data collection was cross-sectional (18 months after the work-related injury), which could potentially lead unemployed respondents to overestimate their pain levels. Understanding the size of this bias would benefit from a repeated survey longitudinal study design. Second, survey variables are self-reported, potentially introducing measurement bias particularly related to mental health and questions related to the return-to-work process. Therefore, these variables may be under-reported. Third, missing data were present in the LOE earnings and healthcare benefits outcome variables. While no differences in health or demographic characteristics were seen among those with the missing data versus those with no missing data, if data are not missing at random, results will be biased.

Fourth, it was our expectation that both the nature of injury and economic sector (industry) would have been associated with persistent pain (with industry being a determinant of nature of injury). The absence of a strong association between specific nature of injury categories and persistent pain may be an artefact of the somewhat coarse nature of injury applied in this analysis; further research should explore more detailed and nuanced industry and injury types associated with subsequent persistent pain. Lastly, the study sample did not include individuals who experienced a psychological-related workplace injury of illness, or workers who experienced a work-related injury at a workplace not entitled to provincial WSIB coverage; results cannot be generalised to these populations of workers.

CONCLUSIONS

Among a cohort of Ontario workers who received lost-time benefits for a work-related injury, we found ∼70% of participants reported persistent pain at 18 months postinjury, with ∼25% of participants meeting our definition of severe, persistent pain. When compared with no pain at 18 months, a gradient effect of mild and severe pain on increasing wage replacement duration, the amount of lost earnings benefit dollars and amount of healthcare benefits was seen for both men and women. This study may inform employers and employee benefit providers about the highly prevalent nature of chronic pain following a

work-related injury, and its strong impact on disability duration and amount. The findings of this study would support future research to explore how various types of healthcare access, more nuanced injury categories (eg, injuries requiring surgery), and receiving multidisciplinary treatment influences pain intensity, as well as duration and amount disability benefits received. Methodologically, future research should explore the trajectory of persistent pain after work-related injuries using longitudinal cohort studies.

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